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Ubiquitous Access for Computational Science and Education

by

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Ubiquitous Access for Computational Science and Education

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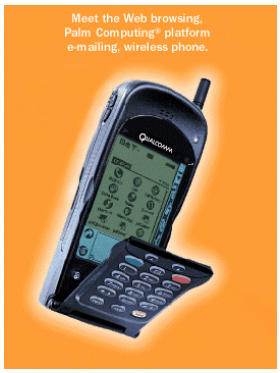
1. Introduction

Louis Turcotte, former Government PET Lead at ERDC MSRC produced a survey (in the form of a PowerPoint presentation) of the different uses explored for small devices**.** Some examples are given below.



A major thrust in this area is the expected confluence of cell phone and personal digital assistant as universal wireless portable systems. As specific motivation it is estimated that by 2005, 60 million Internet-ready cell phones will be sold each year and that 65% of all Broadband Internet accesses will be via non-desktop appliances. This suggests that hand held wireless devices will play a more and more important role in areas now dominated by desktop clients. This will enable new applications and new approaches to old applications. Thus during this year the ways palmtops could be used to support high performance

computing and training or education applications have been examined. Prototypes have been produced, from which descriptions and lessons learned from the architecture and implementation work and the early use of the systems are given.

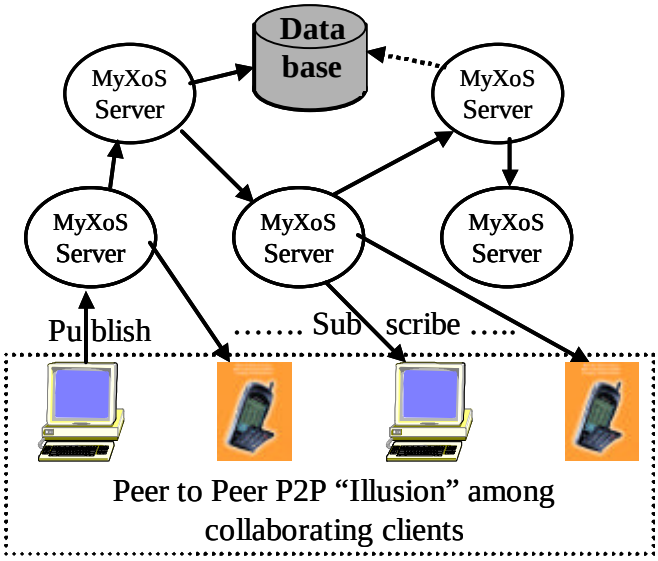
2. Base Technologies

Last year the base technologies were studied in general – especially the WAP and WML protocols and the Bluetooth hardware communication standard. [1] This year what actually worked in practice was understood more! More was learned at the Grid on the Go workshop [2] but it appears that WAP and WML, which are optimizations of HTTP and HTML, may not make it. Currently there is a serious economic downturn in the telecommunications area and this has delayed introduction of the new infrastructure, which could broadly use WAP and WML. The deployment of data-aware (third generation) phones with integrated PDA capabilities will certainly happen. However maybe by that time there will be no need for WAP and WML. Rather the use of identical protocols will be preferred for both desktop and non-desktop devices; this is a classic trade-off between the optimized approaches versus the clumsier but broadly understood and deployed technology. In the present work either HTTP or conventional Java sockets is used to communicate with the palmtop; data is sent that was not in WML but in a format that was optimized for existing palmtop applications. Good experience with this method suggests use of desktop communication systems for palmtops will be important.

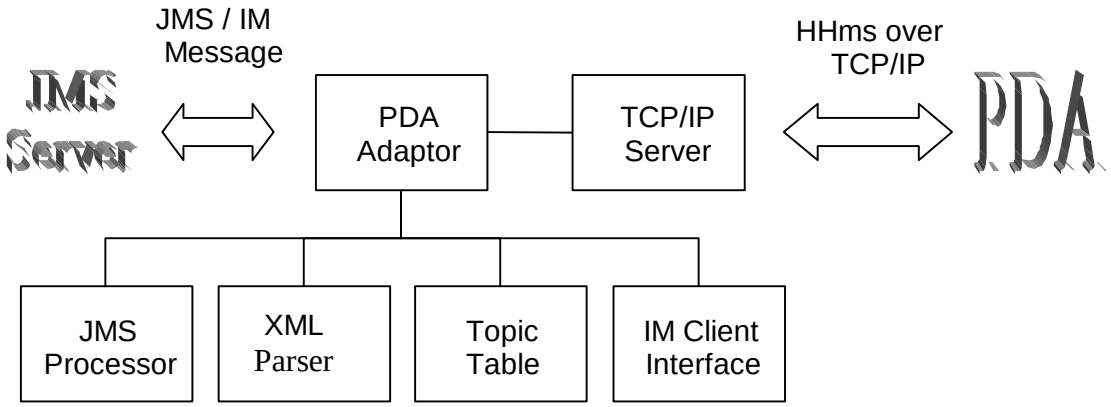
The new Bluetooth standard will enable pervasive short distance wireless links. However Bluetooth is not yet available for many devices and we do not have the necessary access points deployed. Bluetooth supports different power levels but the attractive low power option has very short range (a few meters). Thus it does not seem easy to deploy within a largish area like a research department. Rather the standard here is the 802.11b standard which is high-bandwidth (11 megabits per second), good range (100 meters) and a commodity item – you can purchase at Amazon.com. Thus this protocol is expected to be used in "department" applications such as classrooms or computer centers. Deployment of 802.11b and other wireless infrastructure is subject to serious security concerns in DoD and this needs further research. 802.11b interfaces are quite expensive (a significant fraction of cost of a PDA) and it is not clear what will be the low cost high bandwidth winner. An early use of Bluetooth is expected to be in naturally small environments such as enabling communication between the laptop, PDA and cell phone. In the wide area, infrastructure like Palm.Net or digital cell phones can be used for wireless communication – currently in the 14.4 Kbaud bandwidth range. One will presumably always see a hybrid environment; high-performance wireless in local areas with a geographically broader and slower infrastructure.

The situation may be moving slower and in somewhat different and more conservative technical directions than expected. Nevertheless the revolution will happen and the construction of handheld accessible web sites by a broader community should be seen. The current "closed garden" approach typified by Palm.Net, where the wireless web sites are high quality but proprietary, should be avoided.

3. Architecture of Collaborative Handheld devices



The best way to integrate palmtop devices into the Garnet collaboration system has been studied. Garnet is built around the notion of a publish/subscribe message service shown in the figure to the left, which keeps the state of shared objects consistent between the collaborating clients. As explained in another report [3], information about the shared object is exchanged, but it is rendered separately for each client. This is implemented using an adaptor sitting between the palmtops and the Garnet collaboration system. The adaptor looks like a conventional desktop client to the message service (currently JMS, the Java Message service). It then uses a special lightweight protocol HHMS (HandHeld Message Service) to communicate with the palmtop. HHMS could take a very different form for each type of palmtop.



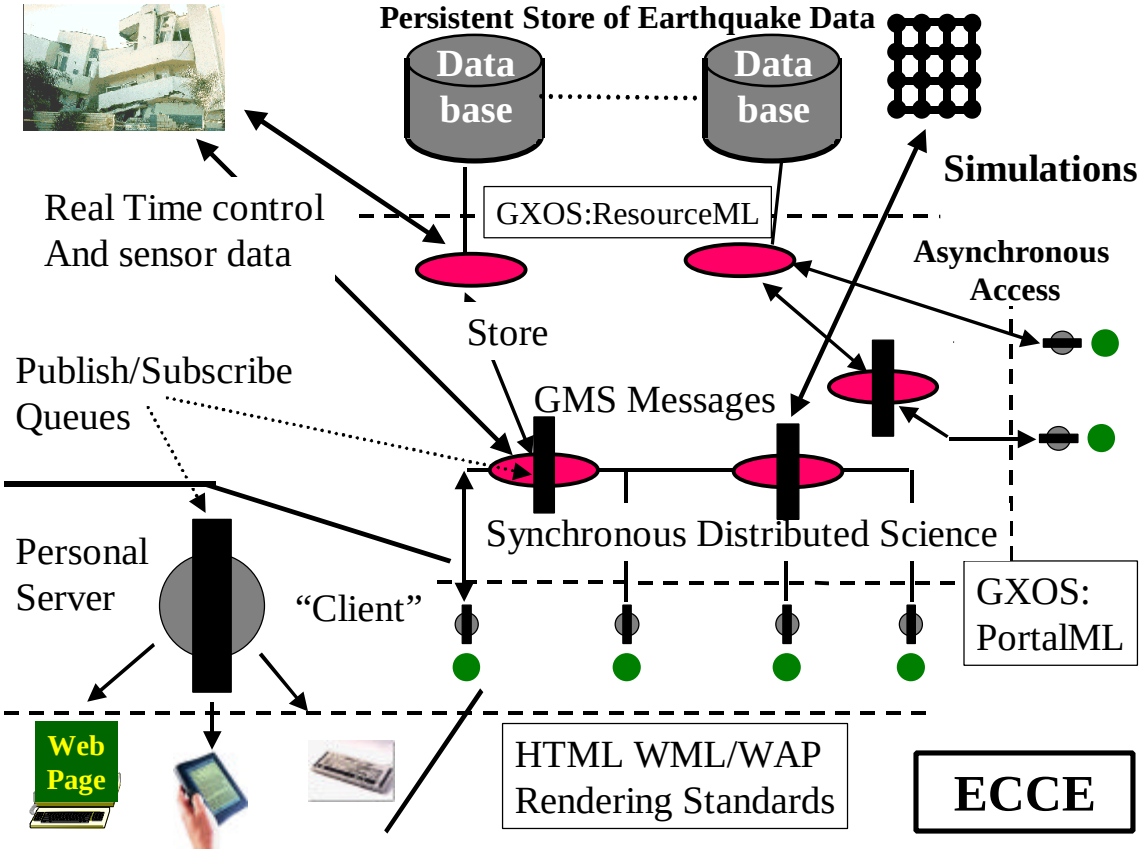
For the initial experiments, the Compaq iPAQ is used with an 802.11b wireless connection to an access point connected to the local intranet. Here Java sockets are used to connect "personalJava" on the iPAQ to the adaptor. The Palm 7 connection to the local intranet will on the other hand use HTTP over the much slower Palm.Net service.

Analogously the intermediate adaptor can simplify a shared export of XML files, such as HTML or SVG, so they can be handled by the less powerful palmtop. For instance, the Batik SVG viewer being used does not currently run on the palmtop. In this design, Batik runs on the adaptor and transmits a simple file to the palmtop, which it can display. The figure above illustrates some other possible adaptor services including parsing complex XML messages.

The Garnet collaboration system supports shared display, instant messenger (from the open source http://www.jabber.org site), text chat and shared SVG and HTML files. This is discussed further in Section 5.

4. Applications of Collaborative Handheld Devices

Consider the ways palmtops can be included in collaborative sessions such as those involved in training. Students can get quizzes, web-page summaries (thumbnail images) and homework assignments on their palmtops while watching the full curricula on a large high quality display in the lecture hall. The notes can be taken on these small devices and related to the lecture both through the thumbnail image and the timing information carried in the JMS events. The hand held notes and recorded lecture material (the recording is performed automatically in ECCE) can be integrated later at the student's convenience to provide an archive that contains all the information in a form that is indistinguishable from the alternative of using conventional laptops or desktops as student interfaces.

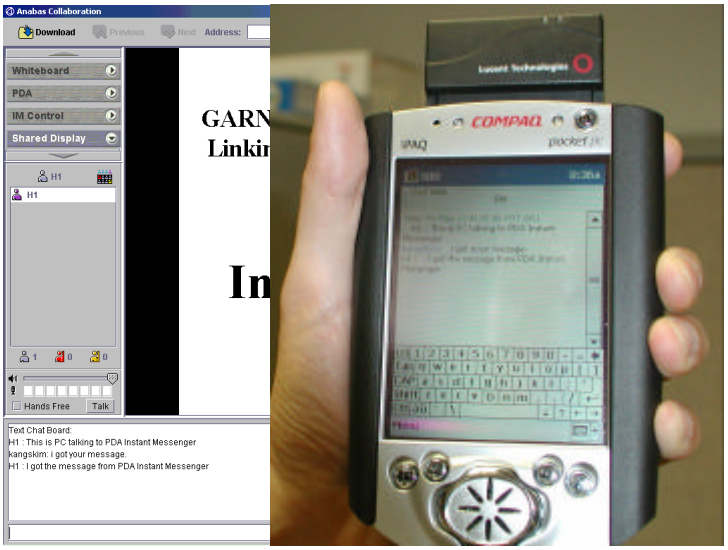


In the figure above, there is a sketch of an architecture to support realtime interpretation of earthquake events using our ECCE environment and both conventional and handheld devices. The realtime nature of such scenarios enhances the value of handheld devices as it allows experts to be brought into a discussion or planning sessions wherever they happen to be.

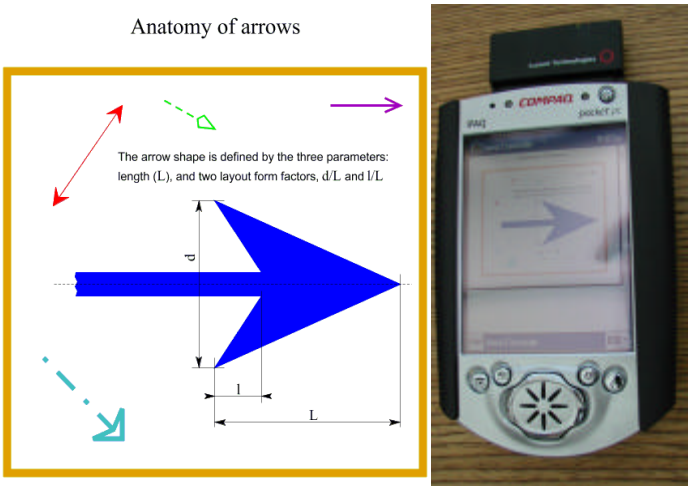
5. Examples of Collaborative Handheld Shared Applications

The figure to the left shows a screen shot of both a desktop and a handheld display sharing a PowerPoint slide using the shared display mechanism. The adaptor runs the basic desktop shared display code and the framebuffer is extracted, resized and sent to the iPAQ with a simple interface code. Interactive options will be added to select the iPAQ image size from the handheld – here the rescaling will be done on the adaptor server.

Note that the latest release of VNC (public domain shared display) for Palmtops shown on the left is quite impressive – it is fast and includes server side resizing for reducing the shared display size. This has not been examined in detail to see the division of work between server and client. It is felt that our dedicated shared display code has several advantages over using VNC (which is how Tango did shared display). One important feature is that the shared display code uses exactly the same JMS event bus as all other applications. This allows a clean architecture with a single archiving and fault tolerance service.



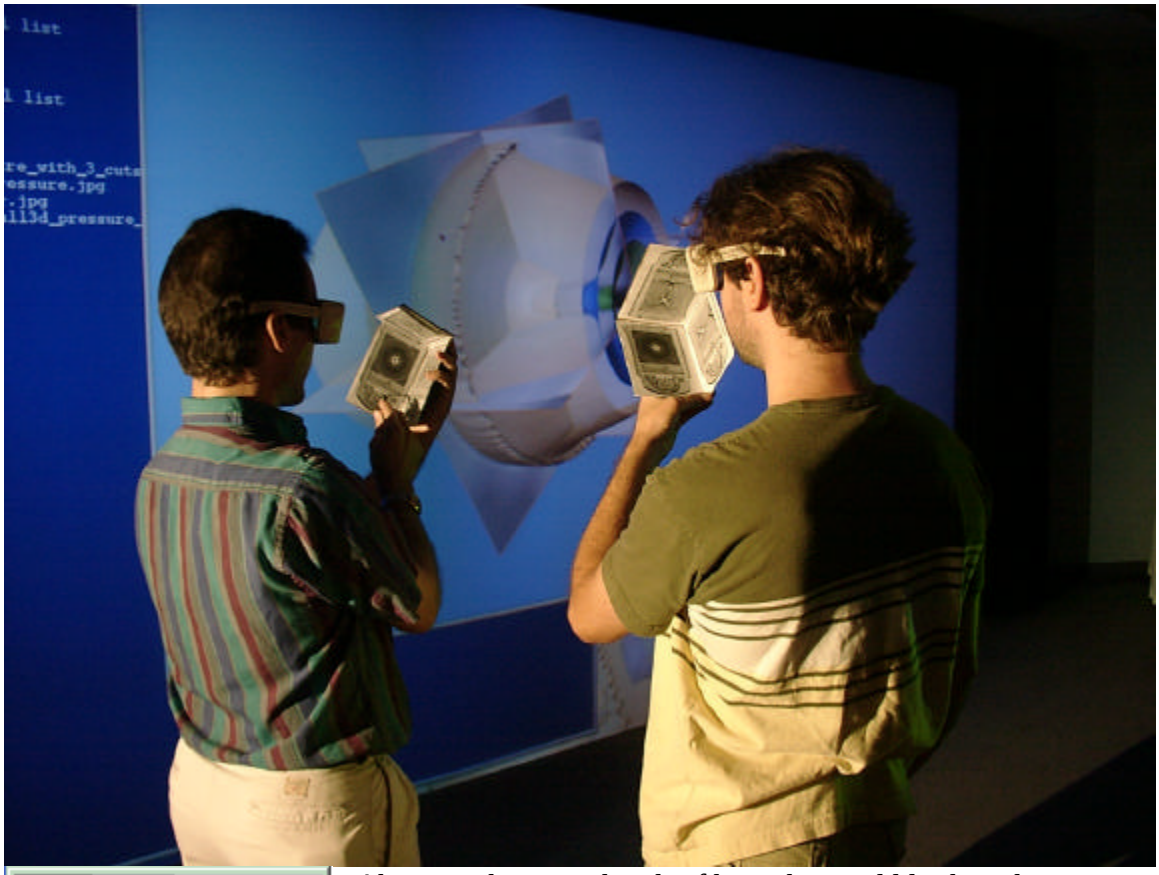
Here another adaptor function is illustrated. The Jabber.org instant messenger in the iPAQ is linked with the desktop chat room.

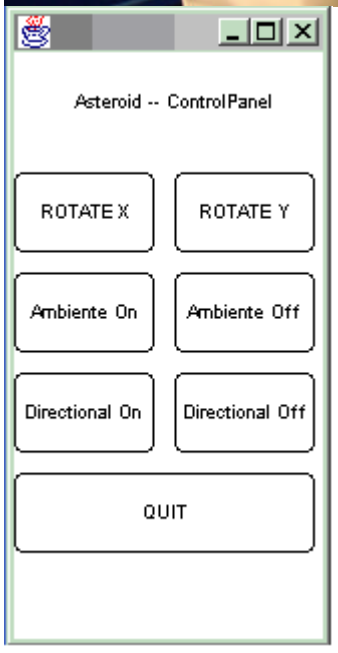


Here shared SVG between desktop and handheld device is illustrated. As PowerPoint and Adobe Illustrator can be exported to SVG, this allows us powerful shared export capability for important authoring styles. SVG is natural for all 2D vector graphics as in the simplest scientific visualization and whiteboards.

6 Collaborative Visualization with Handheld Control

As another example, a demonstration was designed with the FSU visualization group of wireless palmtops controlling high-resolution displays – this produces a much more powerful personal interface than the conventional untethered mouse and keyboard interface. By interfacing palmtops using an adaptor to a portal like Gateway from FSU, job submission and status monitoring from HPC systems can be supported.

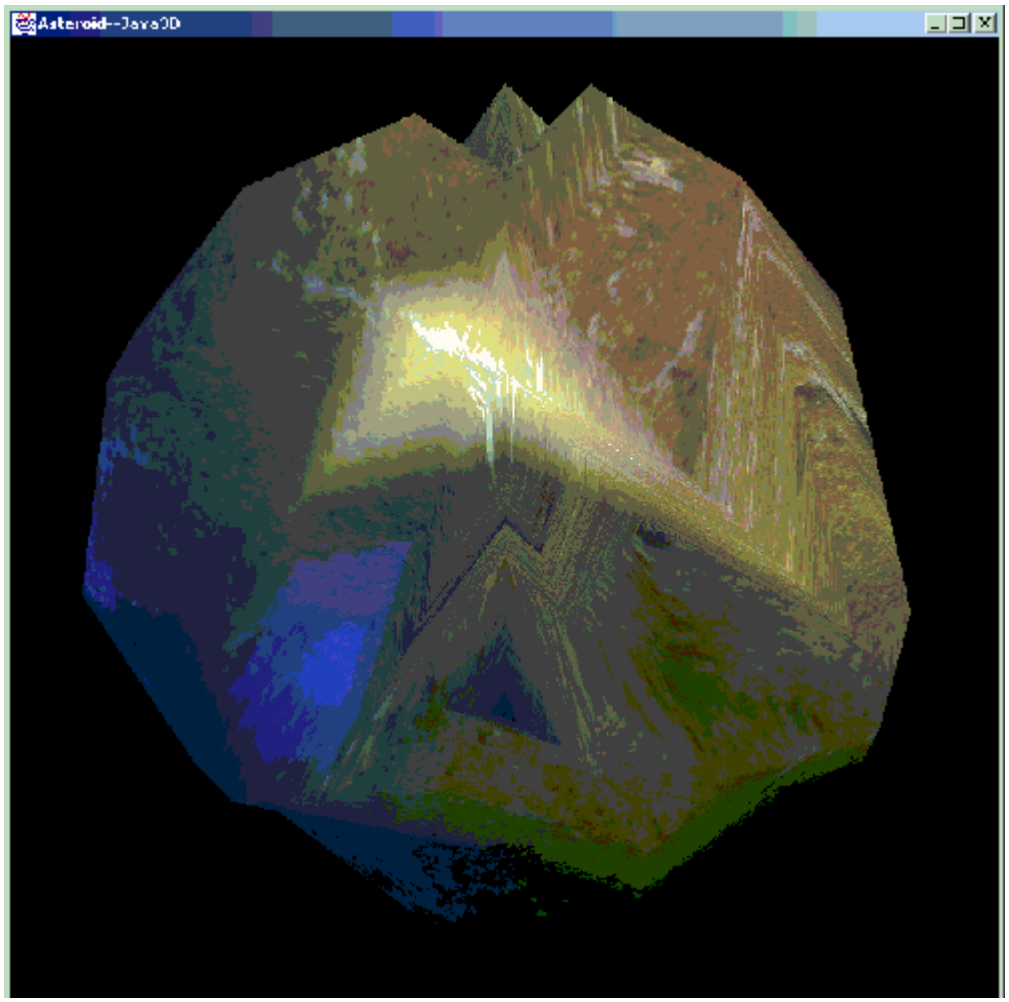




Above is shown a sketch of how this could look with a controller made from 3 handheld devices – one for each of the two dimensional slices of the 3D object displayed on the large screen.

As a simpler prototype a simple Java handheld controller communicating with a Java3D rendered image on the FSU PowerWall is shown on the next page. To the left is shown the PDA control panel.

Here is the 3D image manipulated by our prototype.



References

1. David E. Bernholdt, Sangyoon Oh, Konrad Olszewski, Geoffrey C. Fox, "Tools for Handheld Supercomputing: an Assessment of the Wireless Application Protocol (WAP)", *ERDC Technical Report May 2000*, http://www.new-npac.org/users/fox/documents/wapmay00/wap-assessment.html
2. Grid on the Go Workshop May 2001, http://www.ncsa.uiuc.edu/gog/
3. Geoffrey C. Fox, " Architecture and Implementation of a Collaborative Computing and Education Portal", ERDC Technical report May 2001.